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ABSTRACT

A pioneer program in computer graphics was implemented at Parkland College (Illinois) to meet the demand for specialized technicians to visualize data generated on high performance computers. In summer 1989, 23 students were accepted into the pilot program. Courses included C programming, calculus and analytic geometry, computer graphics, and computer ethics. During their second semester, students participated in internships. The final program that was developed was a 2-year visualization computer graphics specialist program for an Associate in Applied Science degree. After the conclusion of the original 1-year grant, a summer extension was funded. During summer 1990, 10 students participated in summer internships. Four of them worked together on a project for Motorola, a corporate partner of the National Center for Supercomputing Applications. These students created a program to convert data from an electromagnetic field created by a dipole in free space into images. Thirteen students also attended the SIGGRAPH convention. The quality of the program was demonstrated by success in job placement. Two organizations hired additional scientific visualization specialists just months after hiring a first. The greatest concern of the program was recruitment of new students. (An attached article describes students' experiences in the program.) (YLB)

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ED328699

Final Performance Report

Award Number : V199A90046

Project Title : Advanced Certification Program for Computer Graphic Specialists

Recipient : Parkland College
Champaign, Illinois

Note: This Final Performance Report is composed of two progress reports, one covering the grant period from its inception until June 30, 1990, and the other from that date until August 31, 1990, the grant expiration date.

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TO RICHARD DiCOLA AND CAROLYN PLUMMER
DEPARTMENT OF EDUCATION
WASHINGTON, D.C.

PROGRESS REPORT, JULY 1, 1989 TO JUNE 30, 1990
BY Sunny T. Christensen, Project Director

FY 1989 Cooperative Demonstration Program (CFDA No. 84.199A)

AWARD NUMBER	:V199A90046
RECIPIENT	: Parkland College 2400 West Bradley Avenue Champaign, Illinois 61821
CONTACT PERSON	: Sunny T. Christensen, Project Director (217-351-2596)
PROJECT TITLE	: Advanced Certification Program for Computer Graphic Specialists
FUNDS	: Federal: $235,033 Non-Federal: $283,244
AWARD PERIOD	: 01/01/89 - 06/30/90
TARGET POPULATION	: Underemployed adults, transfer students, mathematically advanced high school graduates

This program began last summer, 1989, when twenty three students were accepted into the pilot year program. They were all qualified in that they had completed one year of college level calculus and had had some programming background. Most students decided to take Pascal and a Calculus Review course during that summer; these courses were not required but recommended. Three students dropped during the summer because of work conflicts and the full time aspects of the program requirements. (Two of those students have returned this year to complete the program on a part-time basis).

In the fall, the students took these courses: Unix operating system, C programming and Fortran programming along with Computer Graphics I (a course taught by faculty from the National Center for Supercomputing Applications at the University of Illinois). We learned that this was a very difficult load and based on the students' evaluations we have revised the curriculum. It was found that they needed additional, more advanced C programming, that they didn't definitely need Fortran, that their math was still somewhat weak and that it was important to get all these out of the way before taking the Computer Graphics I course. I enclose the final course outline requirements that have been developed due to this pilot year and our faculty and students' experiences.

The students took a course in Computer Ethics which ended up needed a faculty replacement in the middle of the semester because the teaching style of the first faculty person was not working, even slightly, with this group of very bright adults. The students evaluated the second half of the semester as being good but not outstanding. This course will be studied this summer and should have further development for its appropriate content in relation to the overall curriculum.

By the end of the fall semester, I had prepared over thirty potential internships for the students to consider becoming involved in. Over the semester break they each interviewed with individual University of Illinois faculty or local businesses to establish rapport and make the decision to work with someone in the spring. There was some significant shuffling that seemed to work itself out with my suggesting new or other internships the students could investigate. All students received excellent grades for the Fall semester.

The spring semester has allowed the students to focus just on the Computer Graphics II course (also taught by NCSA faculty with plans for Parkland faculty to begin teaching within a year or so) and the student internships. The internships were for 20 hours a week and many, if not all, students put in far more time than 20 hours. The Technical Communications course was very well received and it seemed to fit into the curriculum well. The seminar was taught in conjunction to the internships and covered preparation for employment and what areas of visualization exist that had not been covered in class. Resumes were prepared by all students seeking positions. Many discussions were held about answering interview questions, developing a portfolio, networking, etc.

During the spring semester I lost two students to their full time job commitments, one student whose privately owned consultant company suddenly required his time, and two more students, one who was forced to move away from the area because of family, and one who has not really provided an explanation as to why he left. It is my assumption that that student wanted to take his training exclusively into art applications as that area is where he did his internship work. He was taken from the payroll as soon as this was made evident to me, since I taught the seminar and the internships, I was able to catch his dropping out.

Every student asked has indicated that they are ready to either begin seeking employment in visualization computer graphics or continue on with further education. Five of the fifteen who will be certified this month are going on to finish their bachelors degree or their masters degree in a related field. Two students have already been placed in specific visualization employment on a permanent basis. The remaining eight are planning to work this summer for the optional internship period and seek employment during that time. They will travel to Dallas, Texas to the annual SIGGRAPH conference in August to spend serious time seeking positions. This conference is an extremely important part of the student placement as it is international in scope and devotes much effort to placement and hiring services in the visualization field because this field is so new.

There have been many areas pursued for locating positions and five jobs that are available now have had my student's resumes in application. This will continue throughout the summer. I am sending large mailings to various parts of the country, particularly to high technology companies and academic institutions. Several students want to be hired on a local basis and I am meeting with local companies for that purpose. I have helped the students complete excellent resumes that are accurate but very impressive. It is truly amazing how much they have learned in one year. Please see an enclosed example of one of the students' resumes.

As previously stated, we learned many things from this pilot program that will help new applicants in the future. One is that we must not teach Computer Graphics before or during teaching the programming and teaching any math we feel necessary. We also realize that an Advanced C programming course is absolutely necessary, so we have replaced Fortran with it and made Fortran an optional course. So far, about ten students are applying for the coming semester and I expect several more to apply during the summer, as that is how last year's application process went.

We have had a lot of recognition, both national and international, with many requests for our course content and curriculum, our text and our visuals. I have performed dissemination in California at NASA Ames, San Mateo College, Sun Microsystems, Silicon Graphics and the University of California at Santa Barbara and San Diego. The east coast has been more centered in North Carolina, where the biggest interest appears to be. I did have a request and sent information to a School District of Alexandria, Virginia board member. In North Carolina, there is a new, state funded, supercomputer center. They are going to be teaching visualization techniques throughout the state to their business and academic users. I gave a presentation there and also at EPA in the Research Triangle. I was able to also provide information to North Carolina State, University of North Carolina and Duke University.

I also enclose the budget that we have prepared for the summer extension of three months. Please see Charles Baldwin's letter of May 8, 1990 for that extension request. The budget has been broken into the same line items as previously established. The major change is that the administrative staff budget line would allow the Program Director to work on a full-time basis for the final two months. With so much to accomplish (see letter) it is going to be most helpful if I can work exclusively on this project. I will be able to devote a lot of time to locating positions for the students, to search for private sector and academic scholarship donors to pay for the internships, to perform a computerized study of the processes of student contacts through certification, and to finalize the official end report. The attendance of the SIGGRAPH Conference by faculty, Director and students in August is an extremely important part of the job placement. The students will be able to be matched up with employers who attend, the conference runs for five to six days and we plan to drive from here to Dallas together to save money. By the end of the summer my students will all be placed in visualization computer graphics jobs and the transition of my directorship to the Department Chair of Math and Computer Science will be satisfactorily and thoroughly made.

This project has been more rewarding to me as Director than any other I have had the privilege to work on. The satisfaction of the students is a never-ending source of joy. Please know that I have received compliments on a daily basis about the program but I always say that it wouldn't have been in existence without the Department of Education. Many thanks for your help, encouragement, understanding and support.

Sincerely,

Sunny Christensen

Sunny T. Christensen
Program Director

TO RICHARD DiCOLA AND CAROLYN PLUMMER
DEPARTMENT OF EDUCATION
WASHINGTON, D.C.

PROGRESS REPORT, JULY 1, 1990 TO AUGUST 31, 1990
BY RICHARD D. BENNETT, Project Director

FY 1989 Cooperative Demonstration Program (CFDA No. 84.199A)

AWARD NUMBER	:V199A90046
RECIPIENT	:Parkland College 2400 West Bradley Avenue Champaign, Illinois 61821
CONTACT PERSON	:Richard Bennett, Project Director (217-351-2549)
PROJECT TITLE	:Advanced Certification Program for Computer Graphic Specialists
FUNDS	:Federal: $235,033 Non-Federal:$283,244
AWARD PERIOD	:01/01/89 - 06/30/90
EXTENSION PERIOD	:07/01/90 - 08/31/90
TARGET POPULATION	:Underemployed adults, transfer students, mathematically advanced high school graduates

This program began in the summer of 1989 and was scheduled to end June 30, 1990. Sunny T. Christensen was the project director during that period. Parkland College applied for and received a two month extension of the grant. Sunny resigned effective June 30, 1990 and I replaced her. My name is Richard D. Bennett. I'm a full time instructor in the Mathematics and Computer Science Department at Parkland College. During the Fall and Spring Semesters of the academic year 1989-90 I earned credit in the two computer graphics courses that are in the Visualization Program supported by this grant.

This is a report of the activities during the summer extension. Sunny Christensen has reported the previous activities.

The activities funded by this grant were: summer internships in which ten students participated, a trip to the SIGGRAPH convention in Dallas, Texas, the search for employment of the

Scientific Visualization Specialists trained by Parkland College.

Four of these students worked together on a project for Motorola, a corporate partner of the National Center for Supercomputing Applications(NCSA).

These students created a program to convert data, from an electromagnetic field created by a dipole in free space, into images. This data was calculated by NCSA's supercomputer. The program is interactive and it involves animation. Motorola was so impressed by the results that the company made a videotape which they showed to their scientists and later to the stockholders at their annual meeting.

The students and I agree that those involved in the motorola project had the most positive learning experience. Working together allowed the students to be more creative and to take advantage of their strengths while working on their weaknesses. Due to their enthusiasm for this type of internship and the positive feedback from Motorola, I'm recommending that future internships be done in groups rather than individually.

Thirteen students attended the SIGGRAPH convention in Dallas from August 4 to August 9. Nine of the students traveled on a bus owned by Parkland College. The other four made their own way to Dallas. One of the students and I shared the driving duties. The experience was exhilarating for all of us. Twelve students and I took two day long courses in computer graphics while the thirteenth took one course. We were very impressed by the exhibits and learned from them too. The students went armed with many copies of their resumes. The convention furnished a bulletin board for prospective employers to post job information and a place for job seekers to leave their resumes. Our students were encouraged because their resume's disappeared so fast that they had to xerox more copies. They were later disappointed when no jobs materialized.

The quality of our program was demonstrated by the fact that two organizations hired additional Scientific Visualization Specialists a few months after hiring a first. One of our graduates obtained a job with the North Carolina Supercomputing Center in August. NCSC hired a second visualization student in October. The second student vacated a computer graphics job, obtained in May, at the University of Illinois' Aviation Research Lab. ARL hired the replacement from our program and then hired an additional graduate of Parkland's Visualization Program.

One of our students has been offered a job at NASA's Goddard Space Flight Center. The starting salary offered is $32,500, but our graduate doesn't believe that it is enough to live in the Washington D.C. area. He is negotiating a starting salary and may take the job. This visualization specialist is in the process of earning a Bachelor's Degree at the University of Illinois and he is not anxious to leave school.

I understand that NASA may fly a second student to Maryland for an interview. This student is competent, but he does not interview well. He has searched for employment much harder than any of the others.

Two of the thirteen graduates of our program are employed in related fields. One has stayed with the company where he worked before he started the program. He is now a computer programmer for the company. The other is a typographer in Chicago earning approximately $40,000 per year.

The remaining five students are going to school full time. Three of them are in Masters Degree programs in Computer Science, Applied Mathematics, and Architecture, respectively. One Bachelors Degree candidate is a Computer Science Major at Southern Illinois University and another is enrolled in Mathematics and Computer Science at Parkland College. The latter individual has been promised employment at the Aviation Research Lab when she obtains her Associates Degree in May.

All of the graduates are employed full time or they are full time students except for the one that doesn't interview well. One of the graduate students must remain in this locale. She has indicated that she would prefer to go to school part time and work full time. However she didn't respond when I suggested that she contact two prospective employers last summer. Recently however she has applied for a job with Spyglass, a Scientific Visualization Company. This company has agreed to pay one or more students to do an internship with them next summer. I'm hopeful that she will find the full time employment she seeks.

Our current statistics show that the average salary of the Scientific Visualization graduates is more than $26,000 per year. This average is higher than the mean salary for any other program at Parkland.

Currently I'm aware of three visualization jobs at NASA, some openings at the Environmental Protection Agency site in the Research Triangle in North Carolina, and one position at Spyglass. Each of these three organizations are interested in hiring a Parkland College Visualization Specialist.

The future of this Scientific Visualization Program depends on our ability to recruit new students, the cooperation of NCSA, the cooperation of the University of Illinois, and the ability of Parkland College to place the students.

The placement of the program's graduates shouldn't be difficult for those with good social skills. Many of the first graduating class are extremely interested in the survival of the program. They are quality people and are selling the program. I expect most of the current years class to obtain jobs through contacts developed by former.

The University of Illinois and NCSA have recently reaffirmed their commitment to this program. This allows us to continue to use the twenty Silicon Graphics Personal Iris work stations in the REL laboratory at the Beckman Institute.

The greatest concern at this time is with recruiting. Our current class is small. We started with twelve students and currently have no more than ten students in the program.

The success of last years students should help us recruit more successfully in the future. The September-October issue of the NCSA newsletter, "Access", contained an article on our visualization program. A copy will be included. See pages nine and ten. 1000 copies were purchased with grant funds. The article helped to convince the people at NASA to make the job offer. Mailing the newsletter to students that have previously inquired about our program is the most effective recruiting tool I have used. I'm hoping to get a similar article in the local newspaper.

We are still in the process of making a video tape of images produced by last years students. This also should be useful with prospective employers and new recruits.

This year we introduced a new course called "Advanced C" to the curriculum. This is a Data Structures class, which is a requirement for Computer Science majors at four schools. We have decided to change the name to "Data Structures in C". This should help in getting the class to transfer to other colleges.

We are proposing some major changes in next years program. We want to change the Visualization Program from a one year certificate program to a two year Applied Associates Degree Program. The second year will be the same as the current program except for the addition of a Numerical Analysis class. The first year will consist of courses designed to prepare the students for the second year such as English 101, English 102, Calculus I and Calculus II. A copy of the proposal is included.

Summer expenditures are also enclosed. Thanks to the Department of Education, Parkland College has the only Scientific Visualization Curriculum in the country. We encourage similar programs. Other visualization programs could only help us.

Richard D. Bennett
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Champaign, Il 61821
Telephone (217) 351-2549

VISUALIZATION COMPUTER GRAPHICS SPECIALIST
Mathematical and Computer Sciences Department
Program Code: MVCG AAS

Associate in Applied Science (A.A.S)
Minimum graduation requirement -- 61 semester hours[1]

The Computer Graphics Visualization Specialist Program prepares the student to create scientific, mathematical, and engineering imaging on a computer graphics workstation by translating large amounts of numerical computer data (including supercomputer-generated data) into high quality 2-D and 3-D graphics simulations. This program can lead to employment in research, education, and/or applications in a wide variety of high-technology fields.

FIRST YEAR

FALL SEMESTER	Cr. Hrs.
ENG 101 Composition I	3
MAT 128 Calculus and Analytic Geometry I	5
CSC 122 or CSC 124[2] Scientific PASCAL Programming or Scientific FORTRAN Programming	3-4
Social Science or Humanities Elective[3]	3-4
	14-16

SPRING SEMESTER	Cr. Hrs.
ENG 102 Composition II	3
MAT 129 Calculus and Analytic Geometry II	4
CSC 126 C Language Programming	3
CSC 128 UNIX Operating System	3
Social Science or Humanities Elective[3]	3-4
	16-17

SECOND YEAR

FALL SEMESTER	Cr. Hrs.
ENG 250 Technical Communications	2
CSC 220 Data Structures in C Language Programming	3
CSC 131 Computer Graphics I	4
ART 272 Illustration II	3
MAT 228 Calculus and Analytic Geometry III and Introductory Matrix Theory	5
	17

SPRING SEMESTER	Cr. Hrs.
PHI 110 Computer Ethics	2
CSC 132 Computer Graphics II	4
CSC 297 Cooperative Education Computer Graphics Seminar	1
CSC 298 Cooperative Education Computer Graphics Experience I	4
CSC 226 Introduction to Numerical Analysis	3
	14

SUMMER SESSION (Optional)	Cr. Hrs.
CSC 299 Cooperative Education Computer Graphics Work Experience II	4
	4

(pending state approval)

[1]Students must also fulfill the constitutional examination requirement (see p. x) and other graduation requirements as listed on p. x.

[2]Scientific BASIC should be the first programming course for a student that has no programming experience.

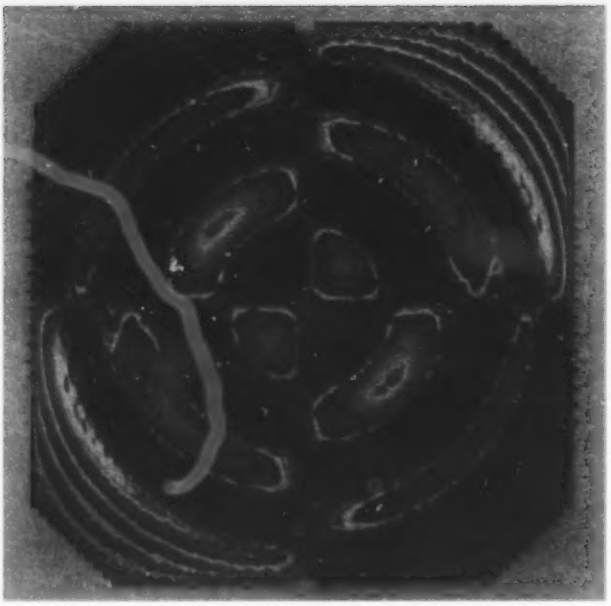
[3]For general education elective courses, see p. x.

Scientific visualization: like playing piano

by John Melchi, Public Information Intern

A pioneer program in computer graphics at Parkland Community College is being offered to meet the demand for specialized technicians to visualize data generated on high-performance computers. Students are trained to create images on a computer graphics workstation by turning numerical data into graphic simulations. The 1-year vocational program is the nation's first [see ***access***, May–June 1989], and it is graduating a new generation of technicians schooled in computer graphics who are ready for the competitiveness of jobs in science and industry.

Students are experiencing teamwork on visualization projects by assisting NCSA industrial partners like Motorola, Inc. They evidence a natural propensity for art and science and communicate an enthusiasm for scientific visualization.



Electromagnetic field generated by a dipole in free space visualized by Motorola interns David Bennett, Ron Carbonari, Don Colby, and Sharon Yeakel. (Courtesy Motorola, Inc.)

Retooling for a career change

By age 5, Don Colby was already learning to play the piano. In elementary school he played the string bass. As an adult he taught music history and string bass at the University of Texas–El Paso. Colby's love for music and art eventually conceded to the demands of raising a family of five, so he returned to Illinois where he later began working on industrial computers.

In 1988 at age 42, Colby left the work force as a digital computer mechanic at Chanute Air Force Base in Rantoul to attend college full-time. Colby soon discovered the computer graphics program at Parkland and decided to pursue two lifelong pleasures: art and science.

Colby is one of 13 students expected to graduate from the "Advanced Certification Program for Visualization Computer Graphics Specialist," says Program Director Dick Bennett. Bennett recently replaced Sunny Christensen, who conceived and developed the original proposal and set up the program, bringing together the institutions and personnel involved.

Like other students, Colby has completed demanding courses in computer graphics taught at Parkland and at the Beckman Institute's Renaissance Experimental Laboratory (REL) by Ray Idaszak and Mike Krogh, NCSA graphics specialists.

"I gain as much pleasure from going to the Beckman Institute and sitting down at a Silicon Graphics Personal IRIS Workstation as I do when I go home and play my piano," Colby says ardently.

He is also collaborating with Bruce Litchfield, UIUC assistant professor of agricultural engineering, who is processing MRI data using the Cray supercomputers to study transport phenomena in foods during their processing. When the research is complete, Colby will visualize the data. He is now studying agricultural engineering and computer science at UIUC.

In addition to meeting prerequisites and completing 12 courses, students are involved in comprehensive internship projects in collaboration with NCSA scientists and other researchers. Colby, David Bennett, Ron Carbonari, and Sharon Yeakel worked as an internship team for NCSA's industrial partner Motorola. They created a set of images used in a company video presentation.

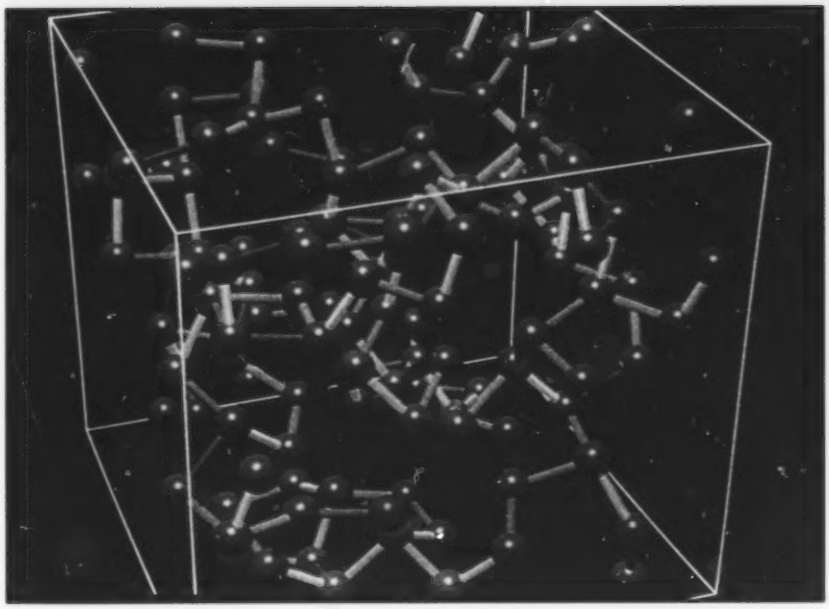
Imaging for Motorola

According to Margaret Nadworny, Motorola's engineering applications liaison at NCSA, the students used Internet and the resources at REL to discover existing tools in the public domain, putting together software used for the Motorola project. The students created time-elapsed images of an electrical field generated by a dipole disturbance from an electromagnetic program. The resulting visualization demonstrated to management and engineers how the software program treats well-understood problems. A basic problem was chosen so the visualization would be clearer to the viewers.

"The visualization increases the power of the computer simulation," Nadworny says. "The purpose was to show higher management that this program and visualization can be used to solve problems of interest to Motorola.

"The students were very enthusiastic. We were impressed with that. We found that their visualization knowledge was very good," she adds. "They were willing to do anything, at any time, under any circumstance. That was very nice. It was refreshing to me.

Scientific visualization *continued on page 10*



Molecular dynamics image of a 124-atom phosphorous configuration visualized by Dave Bock.

Three-dimensional image of data representing sensory responses to four different breads by Don Colby.

Scientific visualization *continued from page 9*

"One expectation of our partnership with NCSA is to transfer visualization expertise, techniques, and capabilities into our company. We want to be exposed to and participate in all the programs available to us at NCSA in order to accomplish that aim," Nadworny said. "Motorola is an industrial partner because we believe supercomputing, visualization, and good science and engineering all play a role in our future as a company."

Starting over with enthusiasm

David Bennett, 43, former business systems director at an extended care facility, also left the workforce to pursue a career in scientific visualization. "I have not regretted it since," he says. "Visualization is the most exciting field out there. I feel like I'm 18 and starting all over again."

In August Bennett accepted a position with the North Carolina Supercomputing Center at the Research Triangle Park as a visualization technician. He will be developing software, providing technical support for researchers and industrial partners, as well as doing visualization. One of Bennett's visualization projects in North Carolina is to assist the Environmental Protection Agency in their study of acid rain and its effect on the environment.

"The enthusiasm of NCSA, the instructors and their dedication and love of doing visualization really helped us. They gave us a lot of support," he says. "Sunny Christensen was an our principal motivator and helped provide stability in a new environment."

Two other students in the program, Jan Moorman and Jean Ascoli, are continuing their education at UIUC. Moorman will pursue a master's degree in computer science and Ascoli a master's degree in architecture. The remainder of the students are finishing their internships and are being assisted by Dick Bennett and Sunny Christensen in finding positions.

This past summer the class expanded their horizons by attending SIGGRAPH '90 to establish potential employment contacts and to learn more about computer graphics through participation in conference activities. "We came back enthused," says Bennett. To continue the momentum, Bennett and several students operated a promotional display of student visualizations on a graphic workstation at the Illinois State Fair the week after SIGGRAPH. The display was done in collaboration with IBM.

Focusing in on visualization

While reading an issue of *Byte* magazine, Dave Bock first encountered scientific visualization and NCSA. Even though the 26-year-old had graduated from Southern Illinois University–Carbondale in 1987 with a bachelor's in electrical engineering and was already working in that field, he decided to look for a position in computer graphics.

"Just about the time I was ready to give up as I looked for a job in computer graphics," says Bock, "I heard about the Parkland program from a friend. This program is so specific; it is so focused that you know what you will be doing in the end. Because of that, it is exciting. I enjoyed it."

Today Bock is involved in interactive visualization research at Aviation Research Laboratory, UIUC. Bock is determining if the visualizations are answering the questions they were expected to. "I always thought that work was something that had to be monotonous every day," he says. "If that's work, this isn't work." ▲